Blood pressure in a community at high altitude (3000m) at Pooh (North India)

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The population of the Alto Plano of the Andes, both native and white immigrants, have low mean systolic and diastolic blood pressures and a low prevalence of hypertension,¹⁻³ and they show no correlation between advancing age and blood pressure.⁴ This constancy of blood pressure with age has also been reported from Easter Island⁵ in a community living the traditional way of life. In most other populations studied the mean level of blood pressure increases with age.⁶⁻¹³ Change of life style from the traditional way leads to a rise of blood pressure with age and an increase in the prevalence of hypertension.^{5 14 15}

There have been only a few studies of blood pressure on communities living at high altitude and none of a Himalayan community, although there have been reports on urban and rural populations in the northern Indian plains⁸⁻¹³ and a study of blood pressure in a community of displaced Tibetans.¹⁶

We therefore decided to study the blood pressure of a Himalayan community and selected Pooh at 3050 metres. Our objects were (1) to calculate the mean pressures by sex and age; (2) to determine the distribution of systolic and diastolic blood pressure by sex and age; (3) to determine whether there was a correlation between blood pressure and age within sex, and (4) to compare the blood pressures in Pooh with those reported from the northern Indian plains.

Population and methods of study

THE COMMUNITY

The area selected, Pooh, is a Himalayan village at 3050 m in Kinnaur, which is a rugged and mountainous district of the Indian Province of Himachal Pradesh adjoining Western Tibet.

The region is inhabited by a tribal population of mixed origins that can be traced to Vedic Aryans from India, Khash Aryans from the Hindu Kush, and Mongols from Western Tibet. The people have Mongoloid features (fig 1) but their social and cultural life is influenced by both Buddhist and Hindu traditions. The district is rural with the population

Fig 1 Woman and child from Pooh showing Mongoloid features.

living by subsistence farming; it is also arid and the cultivation is sparse and difficult. The staple food is barley and varieties of buck wheat.^{17 18} There are small cottage industries and some petty trading. Hard manual labour is an integral part of the traditional life. Obesity is rare, but a nutritional survey by the Integrated Child Health Development Scheme found that the nutritional state of the children was similar to that of children in the plains of northern India.

The society is polyandrous, and women look after the household as well as the cultivation. The polyandry is not due to lack of women as the 1981 census shows that they outnumber men but is probably attributable to land tenure as no family likes to divide its limited cultivatable land.

THE SURVEY

The survey was undertaken in June 1978 as June was the only month when access could be ensured. Two consultants and a team of interns visited Pooh and camped there for two weeks.

They visited every house in the area and completed a census of all those aged 15 to 74 present in the village and also a list of inhabitants of Pooh who were away at the time of the survey. The sex and stated age of the respondents was recorded unless doubt arose when age was estimated. The occupation and the monthly per capita income was also noted.

The interns were trained before the survey to observe strictly the following points when recording blood pressure.

(1) Mercury sphygmomanometers with 12.5 cuffs were used.

(2) At least five minutes' rest before recording pressures.

(3) The respondent sitting comfortably with left arm slightly flexed at the level of the heart.

(4) Sleeve rolled up carefully and the cuff wound neatly round the arm about 3 cm above the cubital fossa, with the centre of the cuff above the brachial artery.

(5) The cuff inflated rapidly while palpating the pulse to 10 mm Hg higher than the disappearance of the brachial pulse.

(6) Deflation at not more than 3 mm Hg a second and deflation complete.

(7) The palpatory systolic pressure was taken when the brachial pulse reappeared. Then the cuff was re-inflated to 20 mm Hg above the palpatory systolic pressure.

(8) The cuff was deflated as before and the auscultatory systolic and diastolic pressures were recorded with Korotkoff phase I and phase IV sounds respectively to the nearest 2 mm Hg.

After training, the concordance between the measurements of any two interns was satisfactory, but nevertheless the two consultants personally supervised the compliance of the observers during the survey.

The sphygmomanometers were checked and cleaned daily.

We used a single casual blood pressure as this has been shown to be comparable to subsequent measurements.^{6,19} Only if hypertension was diagnosed by the casual reading was a second pressure taken after five minutes' further rest. A respondent was diagnosed as hypertensive if two successive readings were above 160 mm Hg systolic or above 95 mm Hg diastolic.^{6,19}

Results

There were 982 (412 men and 570 women) present and enumerated by the survey; a further 118 men and 28 women who belonged to Pooh were absent. The occupations were 939 farmers, 23 semiskilled, 15 sedentary, and five traders; the per capita monthly income was Rs 100 or less (£5.5) for 950 people, Rs 101–300 for 27, Rs 301–500 for five, and over Rs 500 for two. The number of people, mean value, and standard deviation of systolic and diastolic blood pressures for each sex in five-year age groups is given in the table, and the trend is shown graphically in fig 2.

Fig 2 Mean systolic and diastolic blood pressure by age and sex.

Mean and standard deviation (SD) of systolic and diastolic blood pressure (mm Hg) by age and sex

Age group (years)	Men						Women					
	Systolic			Diastolic			Systolic			Diastolic		
	Frequency	Mean	± SD	Mean	± SD		Frequency	Mean	± SD	Mean	± SD	
15–19	49	105.4	16.1	67.5	11.3		76	108.4	12.7	72.7	8.7	
20–24	75	109.7	11.5	73.4	7.3		109	112.7	12.1	73.9	9.6	
25–29	72	111.1	12.6	74.0	10.4		91	109.6	13.0	72.8	8.8	
30–34	37	117.5	16.3	78.4	11.9		76	107.2	10.3	74.2	9.4	
35–39	59	112.1	12.7	75.4	8.2		59	112.6	14.4	74.2	10.1	
40–44	30	107.0	11.2	72.6	10.5		55	108.2	13.4	72.2	10.3	
45–49	18	104.6	9.3	71.9	7.8		28	107.9	13.2	72.0	8.7	
50–54	26	108.1	11.1	73.8	7.8		30	117.0	14.4	76.1	19.6	
55–59	11	113.6	11.2	79.2	8.0		10	130.0	29.8	85.1	14.3	
60–64	18	110.8	13.1	77.6	9.6		25	121.2	23.5	78.2	12.6	
65–69	5	126.0	19.5	78.8	8.8		4	122.5	5.0	80.0	8.2	
70–74	12	119.2	28.4	79.0	15.4		7	120.0	10.0	80.6	1.5	

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The patterns of these mean values by sex and age are rather complex. In men both systolic and diastolic pressures increase from age 15 to 34 but from 35 to 54 they tend to fall again; after 55 there are significant increases. In women there is a similar pattern of an increase up to age 39 followed by a decline until 49, after which both systolic and diastolic blood pressures rise.

When the mean value of systolic and diastolic BP for each sex are considered as four complete series from age 15 to 74 a simple linear trend can be fitted to all four series, but this ignores the rise and fall in the earlier years. The departure of the means from the linear trends are all significant statistically, although physiologically the rise and fall is not large. The final result is that blood pressures in men are at their lowest at ages 45 to 49 after which there is a steady rise with age; in women blood pressures are at their lowest at ages 40–44 after which they rise again.

The frequency distributions of systolic and diastolic BP for each sex at all ages are shown in figs 3 and 4. All four distributions are skewed positively so that the model or most frequent blood pressure is less than the mean value. In both men and women the model group for systolic BP was 100–110 mm Hg and for diastolic BP 60–70 mm Hg. In women both the systolic and diastolic BPs are more skewed towards the higher end of the distribution, indicating that the mean values for women are higher than those for men.

The prevalence of hypertension by sex and age was five men hypertensive (1.2%) and 14 women (2.4%), a difference that was not statistically significant. Three of the hypertensive men and seven of the women were under 44.

Fig 3 Frequency distribution of systolic blood pressure, men and women.

Fig 4 Frequency distribution of diastolic blood pressure, men and women.

Discussion

The community in Pooh lives a traditional way of life at a high altitude. In this community the mean blood pressures for both men and women show insignificant differences at younger ages but show increases in the older ages. This rise is significant, though it may be considered to be moderate and late in comparison with Western populations. In women the rise in BP occurs at a younger age than in men and the mean systolic and diastolic BPs in women are higher than those in men. Our results are thus at variance with the earlier reports about the constancy of BP with age found in the high altitude community of the Andean Alto Plano⁴ and in the traditional society of Easter Island.⁵ Although the rise of BP occurs at older ages in our study, it agrees with the results of the studies done on displaced Tibetans,¹⁶ in a tribal Indian community,²⁰ and on Navajo Indian women,²¹ who all show a variable rise of BP with age and who live a traditional way of life. In a rural Indian community the rise in BP with age had been found to be independent of body build and socioeconomic conditions.¹¹

Figures 5 and 6 compare the mean values of systolic and diastolic BP in Pooh with those in Allahabad,¹⁸ in urban and rural areas of Delhi,¹² in urban and rural Haryana,^{9,10} and in rural areas of Jhansi.¹¹ These show that mean systolic and diastolic BPs in Pooh were similar to those in the rural areas of Delhi and Jhansi, which are situated in the plains.

Fig 5 Mean systolic blood pressure and diastolic blood pressure of men in the present study (Pooh) compared with rural and urban regions in the plains.

Fig 6 Mean systolic blood pressure and diastolic blood pressure of women in the present study (Pooh) compared with rural and urban regions in the plains.

In Pooh only five men and 14 women were hypertensive, of whom about half in each sex were under 45, but because the population at the older ages decline the prevalence of hypertension rises with age. The crude prevalence of hypertension in both sexes together in this study turns out to be 1.9%, which resembles the prevalence found in Andean Alto Plano (1.7%,⁴ and 4.2%²²). Also some of the studies in the northern Indian plains have shown similar prevalences (3.5%,⁹ 1.7%,¹² and 1.5%²³).

Thus there is a similarity between Pooh and some regions of the northern Indian plains so far as the mean BP values and the prevalence of hypertension are concerned. The way of life that is traditional in these regions might be the factor responsible for this similarity. In Pooh, therefore, any possible effect of high altitude on BP is not apparent.

Further studies on the pattern of BP among high altitude communities in India to confirm the present findings are in progress.

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